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SOLAR/1057-79/05

Monthly Performance Report

ZIEN MECHANICAL CONTRACTORS NO. 1

MAY 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT

ZIEN MECHANICAL CONTRACTORS NO. 1

MAY 1979

I. SYSTEM DESCRIPTION

Zien Mechanical Contractors No. 1 is a single-family residence in Milwaukee, Wisconsin. The home has approximately 1304 square feet of conditioned space. The solar energy system consists of two independently controlled systems: One system serves domestic hot water (DHW) preheating, the other is used for space heating and space cooling. Only the space heating and cooling system is described in this report.

The system has an array of flat-plate collectors with a gross area of 384 square feet. The array faces south at an angle of 53 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage. Solar energy is stored in a rock bin containing 41,250 pounds of rock located in the basement of the house. The rock bin has 2 inches of polyurethane insulation on the outside walls and fiberglass roll insulation in the ceiling. A heat pump delivers solar energy from storage to a heat exchanger located within an air-handler. Heated air is then blown from the air-handler to the load. When solar energy is insufficient to satisfy the space heating load, an electric resistance heater in the air-handler provides auxiliary energy for space heating. The system, shown schematically in Figure 1, has 10 modes of solar operation for space conditioning.

Mode 1 - Storage-to-Heat Pump-to-Space Heating: This winter mode activates when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is less than 10°F above the rock bed temperature. Air is drawn through motorized dampers from storage by the collector/heat pump circulating fan, goes past the heat pump evaporator coil, bypasses the collector, and returns to storage. The heat pump condenser coil and house circulating fan supply energy to the house and electrical strip heaters supplement the heat pump to meet the heating demand.

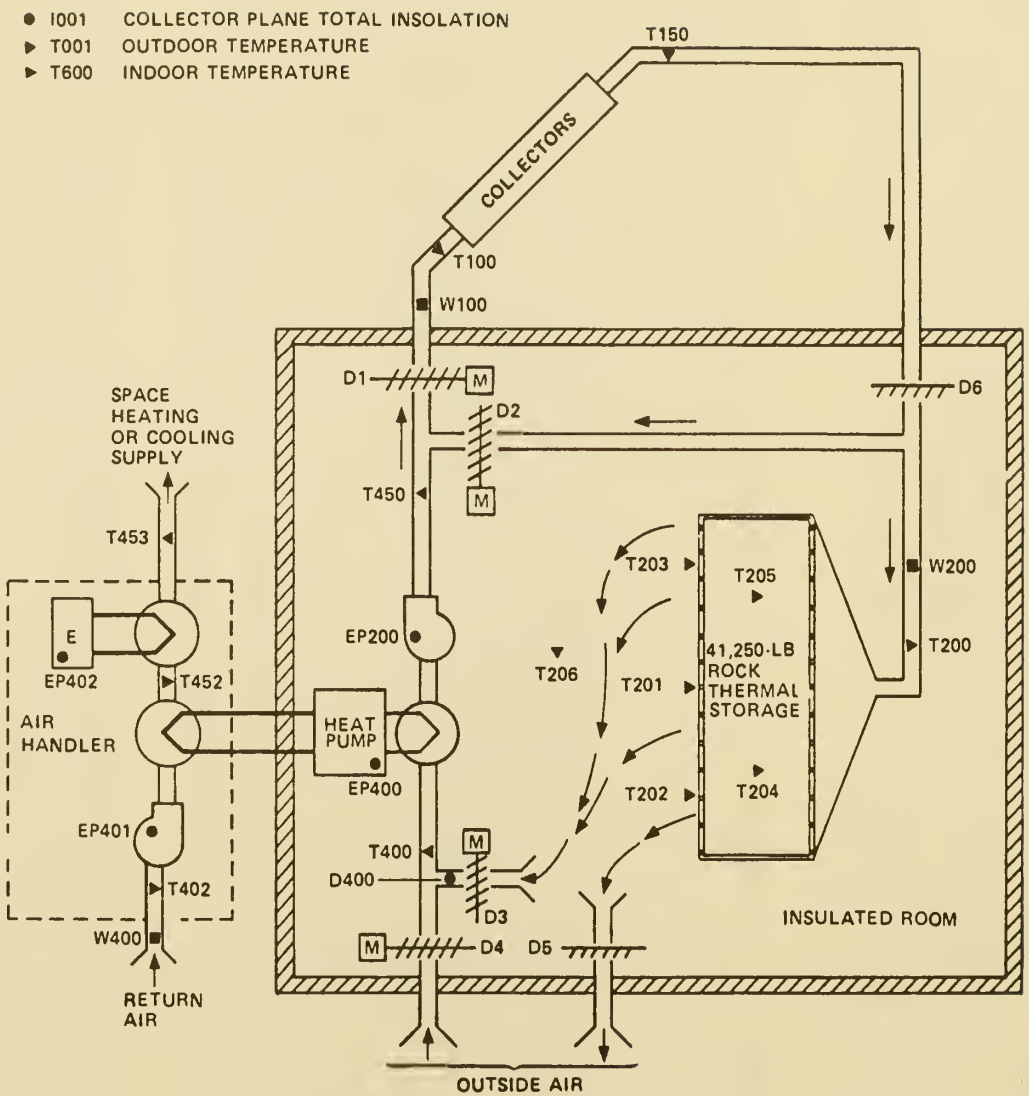

Figure 1. ZIEN MECHANICAL NO. 1 SOLAR ENERGY SYSTEM SCHEMATIC

Mode 2 - Collector-to-Storage: This winter mode activates when the temperature difference between the collector outlet and storage is 10°F or higher, and the outside ambient temperature is less than 10°F above the rock bed temperature. Air is drawn from the collector by the collector/heat pump circulating fan, goes into the rock bin through motorized dampers, and then recirculates through the collector. There may or may not be a demand for space heating.

Mode 3 - Outside Air-to-Rock Bed: This mode activates when the collector loop is inactive, there is no demand for space heating, and the outside ambient temperature is higher than 10°F above the rock-bed temperature. Air is drawn from the outside by the collector/heat pump circulating fan, goes into the rock bin through motorized dampers, and then exhausts to the outside through a backdraft damper in the wall of the insulated room.

Mode 4 - Outside Air-to-Heat Pump-to-Space Heating: This winter mode activates when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is more than 10°F above the rock bed temperature. Air is drawn from the outside through motorized dampers, passes the heat pump evaporator coil, goes through the storage bin, and then exhausts to the outside through a backdraft damper in the wall of the insulated room. The heat pump condenser coil and house circulating fan supply energy to the house. Electric strip heaters supplement the heat pump to meet the heating demand.

Mode 5 - Outside Air-to-Collector-to-Rock Bed: This mode activates when the difference in temperature between the collector outlet and storage is 10°F or higher, and the outside ambient temperature is more than 10°F above the rock bed temperature. Air is drawn from the outside by the collector/heat pump circulating fan, goes through the collector and into the rock bin through motorized dampers, and then exhausts to the outside. There may or may not be a demand for space heating.

Mode 6 - Storage-to-Heat Pump-to-Space Cooling: This summer mode activates when there is a demand for space cooling, the collector loop is not active, and the rock bed temperature is less than 10°F above the outside ambient temperature. Air is drawn through motorized dampers from storage by the collector/heat pump fan, goes past the heat pump condenser coil, bypasses the collector, and returns to storage. The heat pump evaporator coil and house circulating fan remove energy from the house.

Mode 7 - Collector-to-Storage for Cooling: This mode rejects rock bed energy by circulating air through the collector at night. This summer mode activates when the temperature difference between the rock bed and the collector outlet is 10°F or higher, and the rock bed temperature is less than 10°F above the outside ambient temperature. Air is drawn from the collector at night by the collector/heat pump circulating fan, goes into the rock bin through motorized dampers, and then recirculates through the collector. There may or may not be a demand for space cooling.

Mode 8 - Outside Air-to-Rock Bed for Cooling: This mode activates when the collector loop is inactive, there is no demand for space cooling, and the rock bed temperature is more than 10°F above the outside ambient temperature. Air is drawn from the outside by the collector/heat pump circulating fan, goes into the rock bin through motorized dampers, and then exhausts to the outside through a backdraft damper in the wall of the insulated room.

Mode 9 - Outside Air-to-Heat Pump-to-Space Cooling: This summer mode activates when there is a demand for space cooling, the collector loop is not active, and the rock bed temperature is more than 10°F above the outside ambient temperature. Air is drawn from the outside through motorized dampers to the heat pump, passes the heat pump condenser coil, goes through the storage bin, and then exhausts to the outside through a backdraft damper in the wall of the insulated room. The heat pump evaporator coil and house circulating fan remove energy from the house to meet the cooling load.

Mode 10 - Outside Air-to-Collector-to-Rock Bed: This mode activates when the temperature difference between the rock bed and collector outlet is 10°F or higher, and the rock bed temperature is higher than 10°F above the outside ambient temperature. Air is drawn from the outside by the collector/heat pump circulating fan, goes into the rock bin through motorized dampers, and then exhausts to the outside. There may or may not be a demand for space cooling.

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was unoccupied in May and the solar energy system operated continuously during the month. Total solar energy collected was 6.8 million Btu and the total solar energy used was 1.4 million Btu or 21 percent of the collected energy. The change in stored energy was 0.53 million Btu and the total system losses amounted to 5.4 million Btu. Solar energy satisfied 62 percent of the space heating requirements. The solar energy system provided an electrical savings of 0.63 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 17.4 million Btu for a daily average of 1465 Btu per square foot. This was close to the estimated average daily solar radiation for this geographical area during May of 1474 Btu per square foot for a south-facing plane with a tilt of 53 degrees to the horizontal. The average ambient temperature during May was 55°F as compared with the long-term average for May of 54°F. The number of heating degree-days for the month (based on a 65°F reference) was 292, as compared with the long-term average of 348. The number of cooling degree-days was 24, as compared with the long-term average of 13.

THERMAL PERFORMANCE

Collector - The total incident solar radiation on the collector array for the month of May was 17.4 million Btu. During the period the collector loop was operating, the total insolation amounted to 16.0 million Btu. The total collected solar energy for the month of May was 6.8 million Btu, resulting in a collector array efficiency of 39 percent, based on total incident insolation. Solar energy delivered from the collector array to storage was 6.8 million Btu. Operating energy required by the collector loop was 0.42 million Btu.

Storage - Solar energy delivered to storage was 6.8 million Btu. There were 1.4 million Btu delivered from storage to the space heating subsystem. Energy loss from storage was 4.8 million Btu. This loss represented 71 percent of the energy delivered to storage. The storage efficiency was 29 percent: This is calculated as the ratio of the sum of the energy removed from storage and the change in stored energy, to the energy delivered to storage. The average storage temperature for the month was 84°F.

Space Heating Load - The space heating subsystem consumed 1.4 million Btu of solar energy and 0.88 million Btu of auxiliary electrical energy to satisfy a space heating load of 2.3 million Btu. The solar fraction of this load was 62 percent. The space heating subsystem consumed a total of 0.54 million Btu of operating energy, resulting in an electrical energy savings of 1.0 million Btu.

OBSERVATIONS

Large storage losses are attributed to air leakage in the collector loop. The losses are made up by cold air drawn into the insulated room through the outside vents.

ENERGY SAVINGS

The solar energy system provided a net electrical energy savings of 0.63 million Btu. The space heating subsystem contributed an electrical energy savings of 1.0 million Btu.

III. ACTION STATUS

The grantee and IBM/Boeing are expected to investigate the inflow of air through the outside air vents of the insulated room.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ZEIN MECHANICAL-NO. 1 SOLAR/1057-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION:
THE ZEIN MECHANICAL NO. 1 SOLAR ENERGY SYSTEM UTILIZES A SOLAR ASSISTED HEAT PUMP TO HEAT AND COOL A 1304 SQ FT SINGLE FAMILY DWELLING. THE COLLECTION SUBSYSTEM CONSISTS OF 384 SQ FT OF AIR COLLECTORS, TILTED AT 53 DEGREES, TO COLLECT SOLAR ENERGY DURING THE WINTER AND REJECT HEAT PUMP COOLING ENERGY DURING THE SUMMER. A 40 TON ROCK BED IS USED FOR STORAGE. AUXILIARY HEATING IS SUPPLIED BY THE HEAT PUMP WHICH CONTAINS AN ELECTRIC STRIP HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	17.445 MILLION BTU
	45430 BTU/SQ.FT.
COLLECTED SOLAR ENERGY	6.781 MILLION BTU
	17658 BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	55 DEGREES F
AVERAGE BUILDING TEMPERATURE	70 DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.08
ECSS OPERATING ENERGY	0.421 MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.964 MILLION BTU
TOTAL ENERGY CONSUMED	8.627 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	2.307	N.A.	2.308 MILLION BTU
SOLAR FRACTION	N.A.	62	N.A.	62 PERCENT
SOLAR ENERGY USED	N.A.	1.424	N.A.	1.424 MILLION BTU
OPERATING ENERGY	N.A.	0.543	N.A.	0.964 MILLION BTU
AUX. THERMAL ENERGY	N.A.	0.883	N.A.	0.883 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	0.883	N.A.	0.883 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	N.A.	1.046	N.A.	0.625 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.375

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ZEIN MECHANICAL-NO. 1 SOLAR/1057-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION:
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GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	18.405 GIGA JOULES
	515908 KJ/SQ.M.
COLLECTED SOLAR ENERGY	7.153 GIGA JOULES
	200520 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	13 DEGREES C
AVERAGE BUILDING TEMPERATURE	21 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.08
ECSS OPERATING ENERGY	0.444 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	1.017 GIGA JOULES
TOTAL ENERGY CONSUMED	9.102 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	2.434	N.A.	2.435 GIGA JOULES
SOLAR FRACTION	N.A.	62	N.A.	62 PERCENT
SOLAR ENERGY USED	N.A.	1.503	N.A.	1.503 GIGA JOULES
OPERATING ENERGY	N.A.	0.572	N.A.	1.017 GIGA JOULES
AUX. THERMAL ENG	N.A.	0.932	N.A.	0.932 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	0.932	N.A.	0.932 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	N.A.	1.103	N.A.	0.659 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.375

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: MAY,1979

SOLAR/1057-79/05

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.640	43	0.126	N	0.019	N	0.197
2	0.228	47	0.107	O	0.018	O	0.471
3	0.553	48	0.076	T	0.017	T	0.137
4	0.697	43	0.075		0.016		0.107
5	0.414	50	0.083	A	0.015	A	0.201
6	0.679	50	0.041	P	0.015	P	0.061
7	0.737	67	0.019	P	0.013	P	0.026
8	0.530	77	0.000	L	0.012	L	0.000
9	0.610	55	0.001	I	0.004	I	0.002
10	0.624	68	0.020	C	0.013	C	0.033
11	0.263	59	0.016	A	0.010	A	0.063
12	0.396	49	0.065	B	0.014	B	0.165
13	0.324	50	0.062	L	0.014	L	0.192
14	0.567	56	0.045	E	0.015	E	0.080
15	0.778	53	0.040		0.014		0.052
16	0.782	52	0.050		0.014		0.064
17	0.702	68	0.021		0.013		0.030
18	0.419	69	0.000		0.010		0.000
19	0.319	56	0.010		0.008		0.030
20	0.747	57	0.031		0.013		0.041
21	0.737	48	0.042		0.013		0.057
22	0.391	52	0.051		0.012		0.130
23	0.202	48	0.069		0.013		0.342
24	0.731	50	0.064		0.016		0.087
25	0.783	53	0.050		0.014		0.064
26	0.779	54	0.028		0.013		0.037
27	*	*	*		*		*
28	*	*	*		*		*
29	*	*	*		*		*
30	*	*	*		*		*
31	*	*	*		*		*
SUM	17.445	-	1.424	N.A.	0.421	N.A.	-
AVG	0.563	55	0.046	N.A.	0.014	N.A.	0.082
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: ZEIN MECHANICAL-NC. 1 SOLAR/1057-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.640	0.359	0.215	49	0.336
2	0.228	0.222	0.126	48	0.555
3	0.553	0.548	0.277	51	0.501
4	0.697	0.683	0.315	52	0.452
5	0.414	0.386	0.165	54	0.400
6	0.679	0.671	0.275	46	0.405
7	0.737	0.727	0.302	70	0.409
8	0.530	0.527	0.225	79	0.425
9	0.610	0.205	0.114	59	0.188
10	0.624	0.604	0.267	81	0.428
11	0.263	0.242	0.083	56	0.318
12	0.396	0.378	0.149	52	0.377
13	0.324	0.298	0.111	57	0.344
14	0.567	0.549	0.241	63	0.425
15	0.778	0.758	0.320	61	0.412
16	0.782	0.750	0.290	61	0.371
17	0.702	0.688	0.272	72	0.387
18	0.419	0.412	0.170	79	0.407
19	0.319	0.299	0.127	*	0.396
20	0.747	0.724	0.292	69	0.391
21	0.737	0.707	0.266	53	0.361
22	0.391	0.332	0.121	56	0.309
23	0.202	0.142	0.046	49	0.228
24	0.731	0.722	0.305	58	0.417
25	0.783	0.752	0.304	60	0.388
26	0.779	0.753	0.307	64	0.394
27	*	*	*	*	*
28	*	*	*	*	*
29	*	*	*	*	*
30	*	*	*	*	*
31	*	*	*	*	*
SUM	17.445	16.024	6.781	-	-
AVG	0.563	0.517	0.219	60	0.389
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: ZEIN MECHANICAL-NC. 1 SOLAR/1057-79/05
REPORT PERIOD: MAY, 1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.215	0.126	0.149	46	1.278
2	0.126	0.107	0.012	55	0.946
3	0.277	0.076	0.141	60	0.783
4	0.315	0.075	0.115	75	0.603
5	0.165	0.083	-0.111	75	-0.169
6	0.275	0.041	0.103	79	0.523
7	0.302	0.019	0.020	88	0.131
8	0.225	0.000	0.015	95	0.065
9	0.114	0.001	0.005	96	0.060
10	0.267	0.020	0.012	94	0.120
11	0.083	0.016	-0.086	95	-0.832
12	0.149	0.065	-0.037	81	0.189
13	0.111	0.062	-0.038	76	0.219
14	0.241	0.045	0.119	80	0.680
15	0.320	0.040	0.066	88	0.331
16	0.290	0.050	0.005	95	0.191
17	0.272	0.021	-0.040	96	-0.070
18	0.170	0.000	0.007	98	0.041
19	0.127	0.010	-0.031	96	-0.169
20	0.292	0.031	0.060	94	0.309
21	0.266	0.042	0.006	98	0.180
22	0.121	0.051	-0.098	92	-0.393
23	0.046	0.069	-0.117	81	-1.046
24	0.305	0.064	0.196	79	0.853
25	0.304	0.050	0.009	90	0.197
26	0.307	0.028	-0.039	95	-0.033
27	*	*	*	*	*
28	*	*	*	*	*
29	*	*	*	*	*
30	*	*	*	*	*
31	*	*	*	*	*
SUM	6.781	1.424	0.527	-	-
AVG	0.219	0.046	0.017	84	0.288
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: MAY,1979

SOLAR/1057-79/05

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.202	62	0.126	0.048	0.076	0.076	N	0.094	N	68	43
2	0.172	62	0.107	0.040	0.065	0.065	O	0.079	O	68	47
3	0.125	61	0.076	0.031	0.049	0.049	T	0.055	T	68	48
4	0.125	60	0.075	0.031	0.050	0.050		0.053		69	43
5	0.133	63	0.083	0.030	0.050	0.050	A	0.062	A	69	50
6	0.066	63	0.041	0.015	0.024	0.024	P	0.031	P	69	50
7	0.031	62	0.019	0.007	0.012	0.012	P	0.014	P	72	67
8	0.000	0	0.000	0.000	0.000	0.000	L	0.000	L	76	77
9	0.003	46	0.001	0.001	0.002	0.002	I	0.001	I	73	55
10	0.034	59	0.020	0.008	0.014	0.014	C	0.014	C	73	68
11	0.029	56	0.016	0.008	0.013	0.013	A	0.011	A	71	59
12	0.107	61	0.065	0.026	0.042	0.042	B	0.047	B	69	49
13	0.098	63	0.062	0.022	0.036	0.036	L	0.047	L	69	50
14	0.072	63	0.045	0.017	0.027	0.027	E	0.033	E	69	56
15	0.067	60	0.040	0.016	0.026	0.026		0.029		69	53
16	0.076	66	0.050	0.016	0.026	0.026		0.039		69	52
17	0.036	60	0.021	0.009	0.014	0.014		0.015		71	68
18	0.000	0	0.000	0.000	0.000	0.000		0.000		73	69
19	0.017	56	0.010	0.005	0.008	0.008		0.006		70	56
20	0.048	63	0.031	0.011	0.018	0.018		0.023		70	57
21	0.070	59	0.042	0.017	0.029	0.029		0.029		69	48
22	0.081	63	0.051	0.018	0.030	0.030		0.038		69	52
23	0.112	62	0.069	0.026	0.043	0.043		0.051		69	48
24	0.102	62	0.064	0.024	0.039	0.039		0.047		69	50
25	0.079	64	0.050	0.018	0.029	0.029		0.038		69	53
26	0.048	59	0.028	0.012	0.020	0.020		0.020		71	54
27	*	*	*	*	*	*		*		*	*
28	*	*	*	*	*	*		*		*	*
29	*	*	*	*	*	*		*		*	*
30	*	*	*	*	*	*		*		*	*
31	*	*	*	*	*	*		*		*	*
SUM	2.307	-	1.424	0.543	0.883	0.883	N.A.	1.046	N.A.	-	-
AVG	0.074	62	0.046	0.018	0.028	0.028	N.A.	0.034	N.A.	70	55
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COULING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: MAY,1979

SOLAR/1057-79/05

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1666	N	43	49	N	N	N
2	593	O	47	48	O	O	O
3	1441	T	48	51	T	T	T
4	1816		43	52			
5	1077	A	50	54	A	A	A
6	1769	P	50	46	P	P	P
7	1920	P	67	70	P	P	P
8	1380	L	77	79	L	L	L
9	1588	I	55	59	I	I	I
10	1625	C	68	81	C	C	C
11	684	A	59	56	A	A	A
12	1031	B	49	52	B	B	B
13	843		50	57	L	L	L
14	1477	E	56	63	E	E	E
15	2027		53	61			
16	2037		52	61			
17	1829		68	72			
18	1090		69	79			
19	832		56	*			
20	1946		57	69			
21	1920		48	53			
22	1018		52	56			
23	526		48	49			
24	1904		50	58			
25	2038		53	60			
26	2028		54	64			
27	*		*	*			
28	*		*	*			
29	*		*	*			
30	*		*	*			
31	*		*	*			
SUM	45430	N.A.	-	-	-	-	-
AVG	1465	N.A.	55	60	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

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